specimens preserved in this country, I think he will arrive at the conviction which I have expressed at the outset of this paper. It is a comparatively easy task to name afresh every entozoon which happens to come into one's possession; but to ascertain how often it has previously been described may involve a good deal of labour. As an illustration of the truth of the latter remark, I subjoin a list of the synonyms which I believe to belong to the species under consideration:—*Distoma clavatum*, Rudolphi=*D. Coryphænæ*, Rud.=*D. gigas*, Nardo=*Fasciola clavata*, Menzies =*F. Coryphænæ*, Bosc=*F. Coryph. Hippuridis* and *F. Scombri Pelamidis*, Tilesius=*F. fusca*, Bosc=*Hirudinella marina*, Garsin =*H. clavata*, Baird.

Probably we may here also include Rudolphi's *Distoma tornatum*; but I have never seen the caudal extremity of *D. clavatum* projected to the extent described by Dujardin as occurring in *D. tornatum*, though I think it quite capable of becoming so. Diesing, in my view, gives this accidental invaginating process too much prominence as a specific character when he writes, in regard to *D. tornatum*, "Cauda longissima, gracilescente, moniliformi," overlooking the circumstance that the tail is normally truncated posteriorly. Whether the correctness of my opinions respecting the synonymy of *D. clavatum* be admitted or not, I am confident, as regards certain other reputedly distinct forms of this genus and its allies, that they have had a common origin. On this score I may adduce evidence on some future occasion.

Experiments with *Trichina spiralis*.

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The present record may be regarded as a sequel to my paper on 'Experiments with the Cestoid Entozoa' recently submitted to the Society. In conducting these investigations, I have received the friendly cooperation of Professor Simonds, and of Assistant Professor Pritchard, of the Royal Veterinary College.

Exps. 1 and 2. On the 15th March, 1865, an ounce of flesh containing Trichinæ was administered to a small black bitch. The dog was destroyed five days subsequently; but neither intestinal nor muscle-trichinæ were discovered. It was thought that the dog had thrown up the bolus, which was strongly saturated with

chloride-of-zinc solution. The bolus consisted of a portion of the *pectoralis major* of a subject brought to the dissecting-room at the Middlesex Hospital. The cysts were highly calcified; but the majority contained living embryos, which were quite unaffected by the zinc-solution injected into the body to prevent decomposition. At the same date a small white puppy was experimented on and examined with precisely the same results. In either case it was, of course, too early to expect muscle-fleshworms to have become developed.

Exp. 3. Half an ounce of the same trichinous human flesh was given (at the same date) to a black-and-tan puppy reared at the Royal Veterinary College, a second "feeding" being administered on the 21st of March, or six days after the first. In this case Mr. Pritchard, who fed the animal, took the precaution to chop the muscle into small pieces and to mix it with other food, in order that the flesh might be the more readily retained in the stomach. The puppy was not destroyed until the 15th of the following June, when, on examination, numerous encysted but non-calcified muscle-trichinæ were found in all the voluntary muscles subjected to microscopic scrutiny.

Exp. 4. An ounce of the same flesh was given to a dark-coloured pig on the 15th of March, and again on the 20th, several other "feedings" being also administered during the month of April (1865). It was destroyed on the 16th of May; but no Trichinæ were detected.

Exp. 5. An ounce of the same human muscle-flesh, administered to a small sheep (which was subsequently killed on the 29th of June), produced the same negative results.

Exps. 6 and 7. "Feedings" were at the same time administered to a rat and a mouse. The mouse died on the 2nd April, when I examined its muscles without success. On the following day the rat made its escape, but whether trichinized or not I cannot say.

Exp. 8. An ounce of trichinous human flesh was given to a donkey, in the form of "balls," on the 20th of March; and during the month of June four other separate "feedings" with trichinous dogs' flesh were also administered. In this case the animal was parted with without the result being ascertained.

Exp. 9. From the 15th to the 20th March, 1865, inclusive, three small Trichina "feedings" were likewise administered to a guinea-pig. This little animal was not destroyed until the 15th of the following June, when a positive result was obtained. The

pectoralis transversus and other muscles were found to harbour a considerable number of encysted Trichinæ.

Exp. 10. On the 20th March, and again on the 21st (1865), "feedings" from the same human subject were administered to a hedgehog. On the 26th of April the animal seemed to be attacked with symptoms of trichinosis. It refused food, kept its head extended and the eyelids closed. On the 27th it appeared much worse, and on the morning of the 28th it was found dead. On the 29th I examined the flesh and found abundance of living Trichinæ in the muscles. The capsules were very thin and transparent. A few days later Mr. Simonds also examined the flesh, and confirmed this result.

Exps. 11 and 12. Two chickens were fed, on the 21st of March, with the same material. One of the birds died on the 24th, when I examined the intestines and detected one or two very minute nematodes, which, at the time, I believed to be imperfectly developed Trichinæ, but subsequently saw reason to alter my opinion. The other bird died on the 3rd of April, and certainly contained no muscle-trichinæ.

Exp. 13. On the 22nd and 23rd of March "feedings" amounting to an ounce of flesh in all were given to a mole. This animal was returned to the care of Mr. Charles Land, who had previously sent it to the Veterinary College. He subsequently reported that, after observing the mole to be "working" for two or three days, he lost all trace of it, and concluded that it had either escaped or was dead.

Exp. 14. On the 1st and 2nd of May portions of the left fore extremity of the hedgehog (in which we had successfully reared *Trichina* from the Middlesex-Hospital subject) were offered by Mr. Simonds to a cat. The "tabby" ate the flesh very readily, consuming the entire limb. On the 15th of the following June the cat was killed, when living Trichinæ were found within all the muscles which we examined.

Exp. 15. At the same dates a young terrier dog was similarly treated, but did not take the "feeding" so readily. In this case the left hind extremity of the hedgehog was employed, and what was not eaten voluntarily was forcibly introduced. On the 1st of June the dog was attacked with "distemper," and died on the 8th of the same month. On examination we found several living Trichinæ in the *sterno-maxillaris* and other muscles. Some of the parasites were encysted.

Exp. 16. From the 9th to the 12th of June, inclusive, four sepa-

rate worm feedings with the flesh of the trichinized terrier-dog were administered to a crow. The bird was killed some months afterwards and sent to me for examination. Its muscles were entirely free from Trichinæ.

Exp. 17. From the 9th to the 17th of June, inclusive, seven separate worm feedings were administered to a pig. One of the "feedings" was with the trichinized guinea-pig's flesh, the others from the dog. This animal was not destroyed until the 4th of April, 1866, when all the muscles which I examined were found extensively infested with Trichinæ. There were probably not less than 16,000,000 present, all being alive and enclosed within perfectly-formed capsules, none of which latter exhibited any traces of calcareous deposition.

Exp. 18. Four separate "feedings" with trichinous dogs'-flesh were likewise, at the same dates as the foregoing, administered to a rat. This experimental animal, however, like the one previously mentioned, contrived to make its escape. I fear it was well trichinized.

Exp. 19. About the same date trichinous "feedings" were given to a black puppy (bred at the Veterinary College). The dog was killed on the 18th of August, 1866, having also been made the subject of an echinococcus feeding, when I found abundance of encysted Trichinæ within the voluntary muscles.

Exp. 20. Four separate worm feedings with the flesh of the trichinized guinea-pig were given to a sheep on the 15th, 16th, 17th, and 19th days of June, 1865. The experimental animal was destroyed on the 29th of the same month; but the result was negative.

Exps. 21 and 22. "Feedings" with the guinea-pig's flesh—four in the one case and three in the other—were also administered by Mr. Simonds (from the 15th to the 19th of June, inclusive) to a chicken and a goose respectively. These birds were destroyed some months afterwards and sent to me for examination; but the most careful scrutiny failed to detect any Trichinæ within their muscles. The goose was cooked and eaten without the slightest hesitation. The chicken I found too tough for consumption.

Exp. 23. On the 28th of March of the present year, I obtained a small quantity of muscle from a highly trichinized German subject, who died, from the effects of an accident, at the London Hospital the day previous. The case is fully reported by Dr. Thudichum in a new journal called 'Scientific Opinion' (No. 4, April 25, 1866, p. 55). During the same day (at 2.30 P.M.) I

fed a dog with part of this human flesh. On the morning of the 31st I killed the dog and examined the intestinal canal (at 11.30 A.M.), which revealed the presence of sexually mature living Trichinæ. The males (of one of which I retain an accurate figure) displayed the characteristic bilobed caudal appendages, leaving no doubt as to their source and nature. I have mentioned the precise time of the experiment, in order to show that a period of sixty-nine hours proved amply sufficient for the develop mentof the young muscle-fleshworms of the human subject into the sexually mature adult Trichinæ of the dog.

Exp. 24. With another portion of this human flesh (taken from the muscles of the tongue) in which the Trichinæ were extraordinarily abundant, I fed a cat. In about ten days the animal showed the most marked symptoms of Trichinosis. It refused to eat; the eye lost its lustre; the body became very thin, and I thought the animal would die. By very great care, keeping it warm before the fire, and subsequently inducing it to take a little milk, the creature improved, gained flesh, and eventually recovered. About three months afterwards I destroyed this cat, when, on examining the *panniculus carnosus*, *latissimus dorsi*, and other superficial muscles, I found great quantities of well-developed, capsuled Trichinæ. Although the animal had swallowed scarcely a quarter of an ounce weight of infested flesh, yet thousands of parasites had been propagated in its flesh, and a nearly fatal helminthiasis set up. Dr. Thudichum, who saw the trichinized German subject, estimated the number of parasites in his body at 40,000,000. I do not think this estimate likely to be exaggerated; for if all the flesh had been infested to the extent I found to obtain in respect of the muscles of the tongue, I believe 100,000,000 would have been tolerably near the mark. In places, the point of a needle could not be thrust between the capsules, so closely were they agglomerated.

Exp. 25. From the 19th to the 25th of April, 1866, inclusive, daily admistrations of trichinous pork, in the form of bolus, were given to a sheep by Mr. Pritchard. The Trichinæ were from one of our experimental animals at the Veterinary College, about two ounces of the flesh being taken at each feeding. The flesh of the sheep (destroyed in the following November) failed to give any indication of the presence of the offspring of these parasites.

Exps. 26 and 27. About the same time, and occasionally at intervals extending over a period of five weeks, Mr. Pritchard also fed two young fowls with the same trichinous pork. Towards the

close of October, 1866, both birds died, when Mr. Pritchard carefully examined the flesh of them, but failed to find any trace of Trichinæ.

Exps. 28 and 29. From April 2nd to the 9th of the same month, 1866, inclusive, feedings with trichinous pork were likewise given to two more dogs. These animals were destroyed and examined by Mr. Pritchard in November, 1866; but the result appeared to be negative.

Remarks.—Although, at first sight, these experiments do not, on the whole, appear to have been so successful as one might desire, yet the results obtained correspond very closely with those obtained by investigators on the continent. Thus the seven experiments on birds (including 5 fowls, 1 goose, and 1 crow) were all negative. This experience, so far as muscle-trichinæ are concerned, accords precisely with the results obtained by Profs. H. A. Pagenstecher and C. J. Fuchs at the Zoological Institute in Heidelberg. These experimenters, it is true, found that the ingested muscle-trichinæ acquired sexual maturity within the intestinal canal of their avian "hosts;" but they never found young Trichinæ in the muscles of the birds, nor did they perceive any evidences of an attempt on the part of the escaped embryos to effect a wandering or active migration on their own account. Clearly, if the bird's intestinal canal were a proper territory for the residence of sexually mature Trichinæ, Drs. Pagenstecher and Fuchs would have found abundance of wandering and non-encapsuled fleshworms, and we should have obtained (owing to the greater length of time which we generally allowed to elapse before destroying the experimental animals) sexually immature muscle-trichinæ enclosed in well formed capsules with, in some instances, more or less calcareous degeneration. I have put the matter thus clearly, because not a few persons still entertain the notion that Trichinæ are liable to infest all kinds of warm-blooded, and even, also, many kinds of cold-blooded animals, such as reptiles and fishes. Certain nematodes found in earthworms have been described as Trichinæ; and, consequently, pigs and hedgehogs were said to become trichinous through eating these annelids. The minute fleshworms described by Bowman from the muscle of the eel are not true Trichinæ, any more than the somewhat similar parasites (*Myoryktes Weismanni*) which Eberth found to infest the muscles of the frog. The negative results above obtained may therefore fairly be taken as positive, in one sense, inasmuch as they help us, with the aid of other experiences, to define the area of

distribution legitimately assignable to *Trichina spiralis* as a good nematode species. Taken in connexion with what we know touching the limitations of distribution or occupation affecting other species of parasites, the facts have a special and very peculiar significance, one, however, upon which I cannot now enlarge. Deducting, therefore, from the 29 experiments the 7 instances, among birds, where the fleshworms would not develop themselves, and also the three separate cases where the experimental animals escaped, together with one other case where no opportunity of examination was afforded, we have left exactly eighteen mammals in which the results were, in all but two, very carefully ascertained. The exceptions were those of the first two dogs experimented on some two years back. The intestinal canal, or rather its mucous contents, were not sufficiently examined to enable me to affirm positively as to the absence of sexually mature Trichinæ. In a more recent instance (Exp. No. 23) I had evidence of the difficulty of finding the mature Trichinæ in the mucous and half-digested intestinal contents, although the experiment eventually proved perfectly successful. Of course the difficulty of testing the result is a thousandfold increased where only a very small number of Trichinæ have been administered. In the sixteen remaining cases the results appeared to have been fully ascertained; and out of these, nine were perfectly successful. The "negatives" comprised three sheep, two dogs, one pig, and a mouse. The "positives" embraced four dogs, two cats, one pig, one guinea-pig, and a hedgehog. At all events, at least one-half of the experiments on mammals yielded positive results, which, considering all the circumstances of the case, is by no means unsatisfactory. Carnivorous mammals, and especially those which subsist on a mixed diet, appear to be most liable to entertain Trichinæ; nevertheless it is quite possible to rear fleshworms in herbivora. Pagenstecher and Fuchs succeeded in rearing muscle-trichinæ in a calf; and they found three female intestinal trichinæ in a goat, but, apparently no muscle-fleshworms, although twenty-seven days had elapsed since the first feeding with trichinized rabbit's flesh. In our three sheep no trace of Trichinæ could be found. However, on account of the expense, comparatively few experiments have been made on herbivora; and therefore, perhaps, it is as well not to speak too positively from the data already afforded. Not that there is really any practical need for further experiments with this species of parasite; it is quite clear that, in their natural state, herbivorous mammals can seldom have an op-

portunity of infesting themselves, whilst the reverse is the case with swine, carnivorous mammals, and ourselves. Because many quadrupeds may become trichinous, it does not follow that all are liable to be infested. In the case of other parasites (the common fluke, for example) we find them limited to a larger or smaller number of hosts; whilst, on the other hand, in not a few cases, the territory occupied is that of the body of a single species. On this subject I must not now dwell; but I may instance as examples of very limited distribution the two most common cestodes liable to infest the human body. Nematodes, again, display analogous peculiarities of distribution, *Oxyuris vermicularis* being, so far as is at present known, only liable to infest man. Looking at the subject in relation to the public health, I have no hesitation in saying that a great deal of unnecessary fear has been created in this country. No doubt the Imperial authority in Russia has had good grounds for recently issuing an order prohibiting the importation of pork into that country, since severe endemics of Trichiniasis have occurred in neighbouring German states. In this country, however, ordinary precautions will suffice. English swine are almost entirely, if not absolutely, free from this so-called disease; and not a single case of Trichiniasis in the living human subject has been diagnosed in the United Kingdom. Some twenty or thirty cases have been discovered *post mortem*; and it is highly probable that most, if not all, of these individuals had contracted the disease, during life, by eating German pork sausages or other preparations of foreign meat. If further discussion of this aspect of the question were in accordance with the more special aims of the Linnean Society, I would willingly enlarge upon this department of the subject. The mere statement, therefore, of the general practical conclusion at which I have arrived will at least be considered sufficient for the present, and, at the same time, not altogether unsatisfactory.